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**DESCIPLINE: BS – RADIOLOGY**

**SUBJECT:** **THERAPEUTIC RADIOLOGY**

**MID –** **TERM ASSIGNMENT**

**QUESTION NO 1:**

Explain when a patient will be needed radiation therapy?

**ANSWER:**

**PATIENT** **WILL BE NEEDED** **OR GET RADIATION THERAPY:**

* A patient will be needed or get therapy before, during or after surgery.
* Some patients may get or receive radiation therapy without surgery or other treatments means get therapy alone.
* Some patients will be needed radiation therapy and chemotherapy at the same time.
* The timing of radiation therapy depends on the type of cancer which is being treated and processed and on the goal of cancer.
* There are following types of radiation therapy:
1. Pre – operative or neoadjuvant radiation therapy
2. Intraoperative radiation therapy
3. Post – operative or adjuvant radiation therapy

1: **PRE** **– OPERATIVE** **OR NEOADJUVANT** **RADIATION THERAPY:**

* This is the type of radiation therapy which is given before surgery is called pre – operative radiation therapy.
* It is also called neoadjuvant radiation therapy.
* The main reason of giving neoadjuvant radiation therapy is to shrink the cancer or tumor.
* Then this tumor can be removed by surgery.

**2: INTRAOPERATIVE** **RADIATION THERAPY:**

* This is the radiation therapy which is given during surgery is called intraoperative radiation therapy.
* Intraoperative radiation therapy is external beam radiation therapy which contains electrons and protons or brachytherapy.
* During surgery when radiation is given the normal tissues will be shielded physically from radiation exposure.
* Sometimes this therapy is used when the structures which are normal or normal structures are near or close to tumor which allows the external beam radiation therapy to be used and external beam radiation therapy is necessary in that case.

**3: POST** **– OPERATIVE OR** **ADJUVANT RADIATION THERAPY:**

* This is the type of radiation therapy which is given after surgery is called post – operative or adjuvant radiation therapy.
* In abdomen or pelvis radiation therapy is given after surgery which are complicated surgeries and can produce or cause too many side effects, so therefore in these cases the giving of radiation therapy before surgery will be safe.

**CHEMORADIATION** **OR** **RADIOCHEMOTHERAPY:**

* Sometimes chemotherapy and radiation therapy may be required at the same time.
* The combination of chemotherapy and radiation therapy is called radiochemotherapy or chemoradiation which is given or necessary at the same time.
* The combination of chemotherapy and radiation therapy in some types of cancer can kill more cancer cells but it may also have more side effects.
* After the treatment of cancer patients will get regular care from their oncologists to check or monitor or examine their health and check for possible cancer deterioration.

**EXAMPLES OF** **RADIOACTIVE DRUGS:**

* Radioactive drugs samarium -153-lexidronam and strontium -89-chloride (metastron) are examples of radiopharmaceuticals which is used to treat pain which is arrived from bone metastases.

**QUESTION NO 2**:

Write a short note on the following:

**A)** **IMAGE-GUIDED** **RADIATION THERAPY (IGRT):**

* Image-guided radiation therapy is that in which imaging is used during or at the time of radiation therapy to improve the accuracy and precision of treatment delivery or delivery of radiation treatment.
* Image-guided radiation therapy is used for the treatment of tumors that are present in the areas of the body which moves such as lungs, liver, pancreas and prostate gland as well as the tumors that are near or close to normal or critical organs or tissues.
* In IGRT the machines which is used to pass to produce or to deliver radiation like linear accelerator for x-ray or photon or cyclotron/synchrotron for proton is equipped with special imaging technology through which physician is able to image the tumor immediately before or even during the time at which the radiation is passed while the patient will positioned on the treatment table.
* Necessary adjustments are required for the patient position that the radiation is only target on the tumor and avoid reaching healthy surrounding tissue.
* Computed tomography (CT), magnetic resonance imaging (MRI), ultrasound (US) and x-ray imaging may be used for image-guided radiation therapy to see bony or soft-tissue anatomy.
* Other methods that are used for IGRT uses markers which are placed on the surface of patient’s body or implanted within the patient’s body.

**B)** **TOMOGRAPHY:**

* Tomography is a technique for displaying a representation of a cross section through a human body or other solid object by using x-rays or ultrasound.
* Or tomography is imaging by or through the sections using any kind of waves that penetrates.
* In tomography a device is used which is called tomograph.
* The image produced in tomography is called tomogram.
* In many cases the production of tomogram or the images that produced in the tomography is based on the mathematical procedure which is called tomographic reconstruction such as x-ray computed tomography which is produced or developed from multiple projectional radiographs.
* Many different reconstruction algorithms are present such as filtered-back projection and iterative reconstruction.
* Filtered-back projection have fewer computational resources while iterative reconstruction have higher computing cost but chances of artifacts are less.
* By using tomography we can evaluate abnormality of that cross-section that is usually superimposed by underlying and overlying structures in general radiography.

**EQUIPMENT FOR TOMOGRAPHY:**

* They are:
1. A linkage mechanism
2. A pivot unit
3. A mechanical drive
4. A drive control, usually a separate wall-mounted unit
5. Tomographic table

**VARIOUS TYPES OF TOMOGRAPHY:**

* These are:
1. Wide angle tomography
2. Zonography
3. Circular tomography
4. Pantomography
5. Multisection tomography
6. Trans axial tomography
7. Auto tomography
8. Skip tomography

**C) iNTENSITY-MODULATED RADIATION** **THERAPY (IMRT):**

* Intensity-modulated radiation therapy is a highly accurate form of radiotherapy which is controlled by computerized linear accelerators to receive accurate radiation doses to either malignant tumor or specific area within the tumor.
* IMRT control the intensity of the radiation beam in various small volumes so that radiation dose reach more accurately to the three dimensional shape of the tumor.
* IMRT allow high radiation doses to focus more on the tumor while reduce the dose to the surrounding normal critical structures.
* Treatment is carefully given by using the 3-D computed tomography or magnetic resonance images of the patient in association with the computerized calculation of dose to produce the pattern of the dose intensity that will fit accurately to the shape of the tumor.
* Combinations of multiple intensity modulation from different beams produce the radiation dose that maximize the tumor dose while the dose to the normal tissues is minimized.
* As in this case the ratio of normal tissue dose to tumor dose is minimized so more effective radiation doses can safely be provided to tumor with less side effects as compared to conventional radiotherapy techniques.
* It produce less toxicity while the daily treatment time required is long.

**D)** **STERIOTACTIC RADIOSURGERY:**

* Stereotactic radiosurgery (SRS) is a highly accurate form of radiation therapy which is used to treat small brain tumors and functional abnormalities of the brain.
* SRS is a non –surgical procedure that produce accurately-targeted radiation at much higher doses in a single or few treatments as compared to traditional radiation therapy.
* This treatment is possible because of production of advanced radiation technologies to give maximum dose to the target and also reducing the dose to healthy tissues.
* The aim is to destroy the tumor and receive permanent control.
* SRS is commonly a one-day treatment but physicians sometimes referred multiple stereotactic delivered treatments.
* SRS is used to treat:
1. Benign and malignant
2. Primary and metastatic
3. Single and multiple
4. Residual tumor cells following surgery
5. Intracranial, orbital and base-of-skull tumors
* SRS damages the DNA of tumor cells, so that they loss their ability of reproduction.
* When the tumor is treated with SRS arteriovenous malformation thicken and closed slowly.
* Many tumors remains stable and inactive without any change.
* The goal of this treatment is to prevent the growth of tumor.
* When acoustic neuromas are treated with SRS, the tumor either stabilizes or tumor regression occur called pseudoprogression.

**E)** **PROTON THERAPY:**

* Proton therapy is also called proton beam therapy.
* It is a type of radiation therapy that uses protons instead of x-rays to treat the cancer.
* A proton is positively charged particle.
* Protons can destroy cancer cells at high energy.
* It may be used in combination with x-ray radiation therapy, surgery, chemotherapy and immunotherapy.
* Proton therapy is a type of external beam radiation therapy. It passes the radiation through skin from a machine outside the body without causing pain.

**WORKING OF PROTON THERAPY:**

* A machine that speeds up the proton or increasing protons is called synchrotron or cyclotron.
* The high speed of proton produces high energy.
* This high energy is used to make protons travel or to reach the required depth or area in the body.
* After this the protons gives radiation dose to target the tumor.
* In proton therapy the dose outside the tumor is less.

**SIDE** **EFFECTS OF PROTON THERAPY**:

* Itself its treatment is painless.
* May also experience fatigue.
* May also skin problems including redness, dryness, swelling, irritation and peeling.
* There are also other side effects in the case if you also receiving chemotherapy.
* The side effects of proton therapy depends on the part of the body which is being treated, the size of the tumor and the types of healthy tissues that are close to the tumor.

**QUESTION NO 3:**

What are the potential side effects of radiation therapy?

**ANSWER:**

**POTENTIAL SIDE** **EFFECTS OF RADIATION THERAPY:**

* Radiation therapy can cause acute and chronic side effects both which is also called early and late side effects.
* Acute side effects occur during treatment
* Chronic side effects occur months or even years after the treatment ends.

**ACUTE** **RADIATION SIDE EFFECTS:**

* Acute radiation side effects are caused when the division of normal cells in the area which is being treated or cured are damaged.
* These effects includes skin problems or irritation and the areas which are exposed to radiation are also damage. For example damage to the salivary glands or hair loss when the area of head and neck is treated or when the lower abdomen is treated, the urinary problems occur.
* After the treatment ends, most of the acute side effects are not seen means disappear.
* Although the damage to the salivary gland is permanent.
* The drug which is used to prevent the damage to salivary gland is amifostine (Ethyol) ,if it is given during treatment.
* Amifostine is the drug that prevent or protect the normal tissues from radiation exposure during treatment and this drug is called radioprotector.
* The other common side effect of radiation therapy is fatigue despite of which part of the body is treated.
* When the abdomen is treated and the brain is treated the nausea with or without vomiting is also common.
* There are medications used during treatment to prevent nausea and vomiting.

**CHRONIC OR LATE SIDE** **EFFECTS OF RADIATION THERAPY:**

* Depending on the area of body which is treated , the chronic side effects includes:
* Fibrosis
* Damage to the bowels causing diarrhea and bleeding
* Infertility
* Memory loss
* A second cancer is also caused by radiation therapy.
* After radiation therapy the second cancer which is caused or developed is depends on that part of the body which is treated.